FLORENCE RENA SABIN

TEACHER SCIENTIST CITIZEN

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FLORENCE RENA SABIN - TEACHER, SCIENTIST, CITIZEN

by

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Dedication

to

my parents

whose willing sacrifices made possible

my opportunity to study medicine.

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FLORENCE RENA SABIN, M. D.

THE FORMATIVE YEARS

In the early 60's of the nineteenth century a young man, born and raised on a typical New England farm, gave up the study of medicine and left the conservatism and safety of Vermont to go West. The first great gold strike was on in Central City, Colorado, a village now, but then and for years after a rival of Denver in prominence and population. The young man, George Kimball Sabin, a descendent of William Sabin, (a Huguenot who settled in Rehobeth, Massachusetts, in 1643) became a mining engineer. Soon afterward, Rena Miner, a Vermont girl who had been teaching in the South when the Civil War broke out and who had left under a permit by General Sherman, came to teach school in this new Western country, reputed to be Golconda.[1]

Two young people of education, with a cultural background far above that of the rude settlement about them, could not fail to meet. In a short time they married.

Florence Rena Sabin was born on November 9, 1871, at Central City, in the Colorado mining camp country. However, she received all her education in the East, attending first Vermont Academy, Saxton's River, Vermont. Deciding to become a scientist, she entered Smith College, from which she was graduated with a Bachelor of Science degree in 1893. In both the academy and college she distinguished herself in mathematics, zoölogy, and laboratory studies, and by the time of her graduation she had determined to become a doctor. But like many other young, eager students, she was plagued by financial insecurity and the fact that it was tremendously difficult for a woman to receive the opportunity to

study medicine. The first of these hurdles was overcome by teaching mathematics at Wolf Hall in Denver and at Smith College for the next three years, in order to earn money with which to embark on the study of medicine. The second hurdle was not quite so difficult.

The Johns Hopkins Medical School was opened in 1893, the same year that Miss Sabin had been graduated from Smith College. The necessary funds had been contributed by a group of Baltimore women, led by M. Carey Thomas and Miss Mary E. Garrett. The fund was, in the main, given by Miss Garrett, but far more important than the actual money, which determined the time of opening of the new medical school, were the conditions under which the fund was given and accepted. Miss Thomas laid down the conditions which were to be met, namely, a college degree or its equivalent, a knowledge of physics, chemistry, and biology, proficiency in foreign languages and the admission of women on the same terms as men. This was a great event in the history of medicine, for the adoption of these requirements for admission to the new medical school in Baltimore lifted the standards of the whole medical profession in this country and made medicine a graduate subject. Within a short time all the good schools raised their standards of admission, and the poorest schools were closed.[104]

Since Florence Sabin fulfilled these requirements, she was given the opportunity to enroll at Johns Hopkins School of Medicine. She did not hesitate.

Miss Sabin, or "Flossie," as she was often called by those who

knew her well, entered the fourth class of the Johns Hopkins Medical School, one of fifteen women in a class of forty-two. As a medical student she won distinction. Original investigation on the part of the students was encouraged, a tradition which in several schools has become an essential part of the medical student's education today. From the beginning, she attracted the attention of her professors by her accuracy and skill and by the keenness and inspiration of her theories. Because of this it was suggested to her by Dr. Lewellys F. Barker and Dr. Franklin Paine Mall (the latter being professor of Anatomy at Hopkins at that time, and ultimately, one of her dearest friends) that she make a model of the brain stem of a newly born child. This had never been done before.

It is the author's opinion that much of Sabin's greatness stemmed from the unique and ingenious ability with which she developed new methods of attacking the problem she was attempting to solve. The method of constructing models for medical study at that time was the "wax-plate method of Born." This consisted of making sections and then reproducing the outlines of the sections on wax plates with a machine designed for that purpose. The method had already been used by many observers in the fields of embryology and comparative anatomy but no one, except His, had employed it in the study of the central nervous system. At any rate, the models of His represented the development of the external form or the neural tube and the positions of the cerebral nerves. Sabin decided to use this method to show the form of the internal structures, namely,

the nuclei, the nerves and the central tracts. In so doing, she used the medulla, pons, and midbrain of a newly born child. Sabin executed the work with such diligence and ability that the model threw entirely new light on the tracts and the general structure and arrangement of the lower part of the brain. Later on she took her model to Germany, where a firm of professional model-makers manufactured it in finished form. The model and reconstructions of it were used for many years after in the teaching of neurology, both at Hopkins and elsewhere. The results of her first endeavor were published in the Papers from the Anatomical Laboratory of the Johns Hopkins University in 1900.[55] They were also published in "Contributions to the Science of Medicine," dedicated to William Henry Welch, and Volume IX of the *Johns Hopkins Hospital Reports*.

It was then suggested by Dr. H. McE. Knower of the Anatomical Laboratory of the Johns Hopkins Medical School that the description of the model be put into a more convenient form for the student. Consequently, Sabin prepared an *Atlas of the Medulla and Midbrain*, which contained 48 figures of sections cut in two planes and drawn to resemble actual preparations. The atlas was edited by Dr. Henry McE. Knower, and was published by the Friedenwald Company, Baltimore, Maryland, in 1901. Before publication, the little atlas was reviewed by a number of well-known teachers in several large universities and all agreed that it would adequately meet the practical need of some quick and simple, yet full and reliable, means of aiding the student to obtain a reasonably clear idea of the important central relay-station of the region of the brain

presented. The text not only describes conveniently and fully everything figured in Sabin's original reconstruction, but the paragraphs of small print, and others referred to in the headings and index, explain just how to compare sections with the model and how to trace nerve-fiber tracts or masses of gray matter from section to section through this region.[58]

With the success of this endeavor, Florence Rena Sabin's career began. Even before her graduation from medical school, she was exerting an influence on the medical education of her fellow students. For someone else it would have been a great accomplishment, but, for "Flossie," it was just the beginning of what was to become a routine.

She was graduated from the Medical School in 1900. By her training she had been particularly fitted to pursue research. She had chosen this line of adventure, but was in the position of being all dressed up for it with no place to go. Even at the Johns Hopkins Medical School, with its liberal attitude toward the admission of women, a woman faculty member was at that time unthought of. For a year Sabin served as an interne at Johns Hopkins Hospital. It is interesting to note that, even though Sabin's life was devoted to research, she was an excellent diagnostician. One example of this was manifested when, while interning under Sir William Osler on the medical service, Sabin presented a case of fatal arterial disease, quite possibly periarteritis nodosa, in a 32-year old Jewish woman. Up to this time there had been only four other cases that had been described in the literature.[59]

The internship ended -- still no place to go to pursue research. What was so unusual about that? After all, Florence Rena Sabin, M. D., was still a woman, and there was just no place in the professional world for women. At least, that was the general opinion of the day. But even then, the first decade of the twentieth century, women were beginning to band together, to form clubs and organizations in order to obtain recognition. Such early movements were the stepping stones by which, in fifty short years, women would enter, and be eligible for, almost every profession imaginable. So it was no surprise that just one short year elapsed before a position on the research staff of the Department of Anatomy at Hopkins was opened for her by members of her own sex. This group called themselves the "Baltimore Association for the Promotion of University Education of Women" and provided her with an endowed fellowship in 1902. From then on, the course of Dr. Sabin's work has never swerved from its goal. After her fellowship ended, she was appointed Assistant in Anatomy at Hopkins. This was the beginning of Florence Rena Sabin's "first great career," a period which I choose to call "The Hopkins Era."

FLORENCE SABIN - - A GREAT TEACHER

THE JOHNS HOPKINS PERIOD

1901-1924

As an Assistant in Anatomy under Dr. Mall, Sabin began her official teaching career. From the first she had a profound influence upon the medical students who came under her instruction, somewhat over a thousand in number and most of them young men. It might have been supposed that some of them would have objected to being put under a woman teacher, since a majority of them came from men's colleges in which such a relationship was regarded with disfavor, to say the least. As a matter of fact there was never the least indication of a reaction of this kind. From the beginning, Dr. Sabin succeeded in winning the confidence and regard of her students, both men and women. This was apparently done in various ways. Some of her early students attributed Sabin's success as a teacher, to the enthusiasm with which she would go about her duties and to her kindness and maternal protection when guiding and advising her students toward the solution of their problems. Sabin also had definite ideas concerning the teaching. The influence spread by these ideas, which was later to be seen in the teachings of those of her students who were to become teachers, was in reality a reflection of the ideas and principles of the one man who was not only her teacher and colleague, but her chief, her advisor, and most of all, her very dear friend.

Franklin Paine Mall received his medical education at the University of Michigan. The story of his life exemplifies how medical research was started in this country. In 1883, Mall went to Germany; this was the real start of his scientific education. There he studied in the

University of Heidelberg. The next year he spent at Leipzig under Professor His, Professor of Anatomy and an outstanding embryologist. It was from Mall's association with His that these ideas and principles, which were to become the backbone of Sabin's life, originated. As Mall wrote of His:[98]

> When he set a problem it was concisely stated; he outlined the general plan by which it was to be solved. All of the details were left to the pupil and it annoyed him to be consulted regarding them. He desired that the pupil should have full freedom to work out his own solution and aided him mainly through severe criticism.

During the year following, Mall, through extremely fortunate circumstances, went to study in the laboratory of Carl Ludwig, who has been recognized by the medical profession as the greatest teacher of physiology that ever lived. Ludwig was born in 1816, took his medical degree at Marburg in 1839 and then taught both anatomy and physiology at Marburg, Zürich, and Vienna. In 1865 he was appointed to the newly created Chair of Physiology at Leipzig, where he remained until his death in 1895.

Ludwig gave to Mall the full comprehension of the German University, the principles of which are unique in educational history. These principles were, first, complete freedom for the teacher to express his own views, indeed the obligation to teach his own work; second, the freedom of the student to outline his own course, and more important still, to choose his teachers; (This was made necessary, rather than only theoretically possible, by the presence of several teachers, both old and young, in each university giving courses covering the same ground); third, the

pursuit of science for its own sake. This meant that the teachers were themselves professional investigators in their own fields, and the training of investigators became one of the most important responsibilities of the university professor. Herein lay the exceptional ability of Ludwig; it is probable that no one ever trained more men for research than he. He will probably remain in history as a personification of the ideal professor.[99]

Therefore, when Mall came to Hopkins in 1893 as Professor of Anatomy, he organized his department for the inductive method of teaching. This can best be described by Mall himself. In 1896, he expressed his ideas on teaching in an article on his course in anatomy.[100]

> I believe that there is but one way to learn any subject, and that is through study. The very name student tells what the person so named should be doing; and with a natural science, dealing with a most complex object, extending through three dimensions of space, any other method besides studying the object is practically useless.
>
> Lectures with demonstrations are certainly valuable--more valuable than the lectures with text-books alone. Yet analyzing the object itself is infinitely more valuable than to watch the results exposed by another. Wrestling with the part which is being studied, handling it and viewing it from all sides, and tabulating and classifying the parts worked out, give us the greatest reward. All this can be accomplished by practical laboratory work. If we can make the student work thoroughly and carefully, a great result is achieved. It makes of him an artist, an actor, an expert, not a dilettante. He is upon the stage, not in the audience.

This is Mall's fundamental contribution to education--the concept that self-education is the only form of lasting value, the inductive method

with "the student as actor."[100]

Sabin was truly a product of the His, Ludwig, Mall school. Throughout her entire career as a teacher she emphasized the concept of self-education and student investigation in research. "Books are merely records of what other people have thought and observed;" she would tell her students, "the material is a far safer guide."

A pupil in Sabin's histology class at Hopkins in 1909 (Sabin had advanced in 1905 from assistant in anatomy to associate professor of anatomy.) describes her in those days as:

> Dressed very plainly, usually with a plain brown cloth skirt of tweed. No cosmetics. Neat but not ostentatious. After all, business was business. She would lecture twice a week. Very rapidly spoken, a little muddy--she was so enthusiastic in trying to correlate the scientific and medical aspect of anatomy (histology). She would tear up her notes after each lecture so that she would have to work it over the next year.

In reality, she had been a conspicuously able and successful teacher not only in the matter of imparting sound knowledge, but also in the more difficult art of discovering the gifted student and stimulating him to independent work beyond the established routine of the classroom or the text-book. Evidence of this lies in the fact that while one of her distinguished pupils, Dr. George W. Corner, was a student at Hopkins, he organized a Journal Club under the supervision of Sabin. This was composed of five or six students who would meet with her every week, one student being appointed to review a recent paper. She would discuss the paper with them, for she was an excellent critic. One more example of influencing the students toward self-education.

In the words of Dr. William H. Howell as he presented a portrait of Sabin to the Johns Hopkins University at the Commemoration Day Exercises, on February 23, 1920:

> When I think of Miss Sabin's work in the Medical School it seems to me that she has been an ideal university professor. Successful in teaching, productive in research, conscientious and cooperative in all routine duties of an administrative character. Following the admonition of Pasteur she has chosen to dwell in the serene peace of the laboratory and library, and in this environment has given her time and best energies to the work belonging to her position. The professor who prefers to use his talents in the wider life outside the library and laboratory may become a useful citizen or even a public benefactor, but nevertheless he fails in his major duty to his university and his science--for none of us can successfully serve two masters.
>
> . . . . Some such human factor is essential to give color and timbre to the more sober professorial attributes if a sympathetic understanding is to be reached between teacher and student. I fancy that Dr. Sabin's impulsive sincerity has helped greatly to open the way to the hearts of her pupils and friends.
>
> In offering this painting to the University, Mr. President, we, her colleagues, students, and friends, feel that it will be a matter of especial interest in the history of the Medical School to have preserved a portrait of its first woman professor, one of its most distinguished graduates and one who has contributed so much of real worth to the building up of the School and to establishment of its reputation as a center of medical research.[3]

Sabin also felt that research and teaching were inseparable. She often said:

> Research lifts teaching to a high plane. No one can be a really great educator unless he himself is an investigator.[117]

Her attitude that research is an adventure was infectious. Scores of men have gone out from her instruction with that idea, but two in particular remained to work with her--Dr. R. S. Cunningham and Dr.

Charles A. Doan. Before these three notables combined their knowledge and ability, Sabin performed some remarkable research, early in her career.

At the suggestion of Mall, she began a study of how the lymphatic system was developed. At that time it was thought that the lymphatics grew from small openings in the tissues. By means of an ingenious method skillfully applied, she was able to discover the mode of origin and development of the lymphatic vessels of the body. Most of the experiments up to that time had dealt only with small portions of live tissue from various parts of the body. Sabin decided to attempt the study of a living organism as a whole. Her technique was to remove tiny chick embryos from eggs and keep them alive in a warm box under the microscope. They were so rudimentary that the heart had not developed and so transparent that they could be seen through. She was able to observe in these hanging-drop preparations of the living chick blastoderm the differentiation of angioblasts from the mesoderm. The theory proposed from her observations and conclusions was almost revolutionary in its reversal of earlier beliefs. The conclusions, as stated by Sabin:

> The most important result of this study on the morphology of the lymphatic system is the emphasis it throws on the importance of endothelium as a tissue. The angioblast is one of the early tissues to be differentiated; it is not an inert lining for vessels, but an actively growing functioning tissue.
>
> The lymphatic endothelium buds off from the veins. It is always a little different in appearance from the endothelium of the veins and capillaries. The growing lymphatic tip has the remarkable characteristic that it avoids the blood capil-

> laries, while it is attracted by other lymphatic capillaries.
>
> Endothelium is the essential tissue of the lymphatic system. In the lower vertebrates lymph hearts are formed by the addition of striated muscle to primary lymph sacs. In the higher forms lymph glands are formed by the development of lymphocytes around the ducts. This takes place not only in the wall of the primary lymph sacs, but along plexuses of ducts so that there are primary and secondary lymph glands.
>
> The fundamental morphology of the lymphatic system has been established, but there remain many gaps in our knowledge of the system as a whole.
>
> It is now possible to define the lymphatics. Lymphatic capillaries are tubes of endothelium; they are derived from the endothelium of the veins, and they have the same relation to tissue spaces as have blood capillaries.[60]

This was the first work to demonstrate that the lymphatics sprouted from the walls of veins and since then, I believe, it has received great recognition by many anatomical writers interested in this field. In 1903 this paper, entitled "The Origin of the Lymphatic System," was awarded the $1,000 prize offered by the Association for Maintaining the American Woman's Table at the Zoological Station at Naples and the Association for Promoting Scientific Research by Woman "for the best scientific thesis written by a woman embodying new observations and new conclusions based on independent laboratory research." The formation of this association was a great step, for through its agency, impetus was given to all research work among women.[46]

There followed a series of contributions bearing upon the same general subject and appearing in various scientific journals here and abroad. The results of this work have been so important as to connect Sabin's name indissolubly with this topic in medical literature. Her

own contributions, as well as those made by other workers, were summed up and discussed by her in a notable lecture delivered in 1915 before the Harvey Society of New York.

Because of the extremely close relationship between the lymphatics and the blood vessels, Sabin's future investigations were inevitably directed toward the embryology of the vessels themselves, and the significance of the various types, and changes in red and white cells in health and disease.

This research led her to re-study the old problem of how the blood vessels arise and develop, and again working with the blastoderms of chicks, she followed the development of the veins and capillaries in the living specimen. She was able actually to witness the birth of the blood stream--the origin of the red corpuscles developing from minute buds on the walls of the veins and various types of the white cells forming from certain cells in the connective tissue. She was also able to show that the first blood plasma developed by liquefaction of the cells forming the walls of the first blood vessels. By 1919 she published her findings in the Mall Memorial Volume, _Bulletin of the Johns Hopkins Hospital_, a contribution to the knowledge of the origin and development of the blood and blood vessels which was as fortunate and significant as her work on the lymphatic system.

One of the methods of observing the growth of blood vessels was by observing their regeneration in the healing of end-to-end intestinal anastomoses. Sabin and Halsted worked together, Halsted performing the

operations of end-to-end anastomoses on dogs and Sabin observing the regeneration of the blood vessels. By observing the healing of the anastomoses, it became evident that the regeneration of the vessels was limited to specific areas. The endothelium of the old vessels reverted to its original angioblastic type. A great multiplication of the endothelial nuclei then occurred. The latter formed cords, acquired lumina through cytoplasmic liquefaction, and became capillaries and then arteries or veins. The results of this paper were confirmed by similar observations of the embryo and were published in a second article in 1922 entitied, "The Direct Growth of Veins by Sprouting."[64]

Carrying this work to the investigation of the individual cells formed in the red and white cell series, Sabin devised a technique of keeping the cells alive for several hours and by the use of vital staining established criteria for erythroblasts and the differentiation of the three strains of white blood cells on the basis of their specific, vitally stainable granules. With this method, she showed that the erythroblast, forming directly from an angioblast, took on a characteristic granulation by the second and third day and underwent specific steps to maturation. This gave a specific criterion for distinguishing the primitive red cell from the other types of blood cells. She also found that the monocyte made its appearance on the third day of incubation, developing within the vessel from the endothelium. At the same time the clasmatocytes, identical with the monocyte in form, were arising from the endothelium on the outside of the

vessels. Therefore, Sabin proposed that the monocytes of the blood and the clasmatocytes of the connective tissue are derived from the same epithelium and are identical except that one is intravascular and the other extravascular; further, that afterward they are interchangeable, for clasmatocytes were seen to enter the vessel and monocytes to pass out. It was also seen that granulocytes were formed on the third day of incubation from the mesoderm outside of the vessels and that there was no evidence of the formation of the lymphocytes in the yolk sac membranes, even though they were found in the circulating blood on the fourth and fifth days.[66]

Sabin then began studying the differential count by examining drops taken from her own arm, and found a rhythmic rise and fall of the various cells of the blood taken from one person.[78] And in 1923 she reported the first vital differential count which was made on abnormal blood (from a patient admitted to the Johns Hopkins Hospital on October 18, 1922) and showed a fever of a moderate grade correlated with a blood count in which the total number of white cells was normal but in which there were ten percent monocytes. The diagnosis of Malta fever was made by finding the organism in the circulating blood. The differential count, done on November 25, was as follows:[71] polymorphonuclear leucocytes 32%, non-motile polymorphonuclear leucocytes 6.2%, eosinophils 1%, basophils 1%, lymphocytes 39.5%, large monocytes .7%, transitionals (mononuclears) 18.5%.

The value of this work was summed up in Dr. Sabin's own words:[78]

> The fact that there is a fairly constant number of white blood cells per cubic centimeter of blood, and that there are variations of this number characteristic of different types of disease, has become common medical knowledge since the methods for counting blood cells were introduced. There is indeed nothing in the entire animal economy more amazing than the fact that from hour to hour and from day to day, the number of white blood cells remains so remarkably constant. It is wholly obvious that the mechanism involved in the maintainence of this remarkable condition must be one of great importance and it is hoped that the presenting communication may assist somewhat in inaugurating a better understanding of the physiology of the white blood cells.

Before leaving Hopkins in 1925, Sabin, collaborating with two of her former pupils, Dr. R. S. Cunningham and Dr. Charles A. Doan, studied the reactions of the blood cells in disease. The first of these studies was on the maturation of myeloblasts into myelocytes and on amitotic cell division in the peripheral blood in subacute myeloblastic leukemia. Again using the vital technique for staining the cells, the investigators followed the maturation of the myelocytes from the myeloblasts, and found that this was correlated with a decrease in the number of mitochondria and a change in the cytoplasm in its reaction to basophilic dyes in fixed smears. Observing the amitosis in a case of subacute myeloblastic leukemia, they felt that the absence of cell division was the most striking feature and was evidence of a disordered cellular process, since amitosis was so abnormal as to suggest the disordered cell division of neoplasms. The process had none of the characteristic sequence of events seen in the amitotic division of normal cells.[72]

The next challenge that Sabin undertook was in the field of tuberculosis. Her plan of attack was through the role of the monocyte in

its response to tuberculosis. Assisted by a grant from the Research Committee of the National Tuberculosis Association, Sabin, along with R. S. Cunningham, S. Sugiyama and J. A. Kindwall, investigated the effects of the various chemical fractions of the tubercle bacillus on the maturation of the monocyte. This work was begun while Sabin was still at Hopkins, but in 1925 Simon Flexner asked her to join him at the Rockefeller Institute for Medical Research in New York and to carry on her investigations in this field.

Florence Rena Sabin's achievements during her career at Johns Hopkins were many. She was the first woman intern at Johns Hopkins in 1900-1901; the first woman associate professor of anatomy in 1905-1917; and the first woman full professor of histology in 1917-1925. During this time, she was a member of the editorial board of the Anatomical Record and had written extensively on anatomy. She was Vice-President of the American Association of Anatomists in 1909-1910, and was a member of the Association of Collegiate Alumnae.[49]

In 1923, she was named by the League of Women Voters as one of the twelve greatest living women. In making public the names of these twelve women, the committee declared it was "humanly impossible" to know who the really greatest women in the country were and that the selections had been made on the basis of those who had contributed most in their fields to the betterment of the world.[8]

From 1924 to 1926, Florence Sabin was the first woman President of the American Association of Anatomists; and in Washington, on

April 29, 1925, science for the first time in America officially crowned a woman with its laurels by electing Sabin to life membership in the National Academy of Sciences. She was the first woman chosen to membership in the sixty-two years of the Academy's life.[9, 10]

Smith College, her alma mater, conferred upon her the honorary degree of Doctor of Science. Several institutions had attempted to attract her to posts in their faculties. One interesting call of this kind was to the Chair of Anatomy in the Woman's Medical College, London.[3]

And so the year 1925 brought to a close the Hopkins Period and the first great career of Florence Rena Sabin--the career of a splendid teacher. Her own words can best describe the attitude with which she went on to establish her second career--the career of a great scientist. In a presidential address before the American Association of Anatomists in 1925 she declared:[77] "I have ceased to be a professional teacher but remain a professional student."

Florence R. Sabin

SABIN AT THE ROCKEFELLER INSTITUTE IN 1934

FLORENCE SABIN - - A GREAT SCIENTIST

THE ROCKEFELLER INSTITUTE PERIOD

1925-1938

After twenty-three years of active, productive, and influential work, one might safely say that this dynamo from a Colorado mining camp had certainly contributed both to the progress of science and the advancement of medical education, more than one would normally expect during the lifetime of a moderately successful person. But if we familiarize ourselves with the minds and personalities of those men and women who formed the hub of medical science during this era, Mall, Flexner, Welch, Cushing, Osler, Halsted, Howland, Janeway, Avery, Bloom, McCollum and many others, we understand why medicine progressed in leaps and bounds. As Sabin once said when speaking of Mall, "He never fully realized the advances of clinical medicine of his day." This is undoubtedly true of each one of these scientists, including Sabin. It was the Baltimore group that continually tried new methods and instituted better systems of medical education which resulted in the training programs in our medical schools today. It seems that their productiveness never really reached a peak but continued to grow with each passing year. Thus 1925 found Sabin, at the age of 54, beginning at the Rockefeller Institute a new career which was to last for 13 years and which was as productive and influential regarding medical education, investigative research, and individual recognition as the previous 23 years spent at Hopkins.

Much of Sabin's opinion on the progress of medical education can be learned by analyzing her biography of Franklin Paine Mall, *The Story of a Mind*. It was Mall who gave to Sabin a real beginning

in the sphere of medicine. The research that she undertook were problems he presented. Mall was the person who trained, encouraged, and guided her through her early endeavors, and Sabin's opinion of medical education and of teaching were reflections of Mall's ideas. It has been said that Sabin had a "deep filial regard" for Mall. And so it was to be expected, with Mall's death in 1917, that Sabin should carry on in his place.

This can best be understood by knowing that Mall was the one person who was most influential in the fight for full time professors in clinical medicine. The idea that the time would come to put the teaching of clinical medicine on a university basis, Mall got from Ludwig, and although Mall was never in the lime-light, it was he who continually stressed the point that each leader in a department of a true university was both a teacher and an investigator. Mall never made any speeches, but the people who did got their ideas from him. Therefore, it might safely be said that in 1913, when the General Education Board of Hopkins put the Chairs of Medicine, Surgery and Pediatrics on a full time basis, Franklin Paine Mall was indirectly responsible.

This was only the beginning, for the Johns Hopkins University was the first to try this plan and the real problem was not to start the plan but to make it work. History proves that the plan did work, but the advantages had to be weighed against the disadvantages of this system and the latter had to be solved.

Sabin's contribution to this reform can easily be seen by the opinion manifested in a notable address, delivered at the Commencement Exercises of the Woman's Medical College in Philadelphia in 1922, entitled "The Extension of the Full Time Plan of Teaching to Clinical Medicine." In this address, she discussed the drawbacks and the advantages of the full time teacher in the clinical branches of medicine, ending with the following summary:

> . . . all the problems associated with the practical extension of a full-time scheme to the clinical side have not been solved, but that opposition to extending the modern standards of professional education to clinical medicine will yield readily to sound constructive leadership on the part of those who desire this reform.[70]

Because of this close association between Sabin and Mall, it seemed only proper that Sabin should be the one to write a life of Mall. Twelve years after his death, this task was set before her. In October, 1929, Sabin wrote the following letter to Dr. Harvey Cushing, who was at the Peter Bent Brigham Hospital in Boston, Massachusetts, and with whom she had been corresponding regularly:

> October 23, 1929
>
> Dear Doctor Cushing:
>
> I have been asked to write a life of Doctor Mall and I can assure you that I am daily sending up a prayer for about one-tenth of your ability in putting through such a task!
>
> I could not make clear what a perfect delight your address the other day in Baltimore was to me.
>
> Would you be willing to look over your correspondence to see if you have any especially interesting letters from Doctor Mall and also to glance back in your memory for any stories that might be of value to me? You have had such experience in this type of work that I know anything you would send to me

would be of the greatest possible value. I am going to try to describe Doctor Mall in terms for which, as far as I can make out, only the chemists have adequate names - and they have a whole series: Catalyzer, enzyme, activator, etc. I am playing with the idea of a comparison of the Luther and the Erasmus type. It seems to me quite appropriate, with Mall, of course, as the Luther type, and, of course I shall never mention it, but Doctor Welch as the Erasmus type.

Now then, don't tell on me and please help me out.

Very cordially yours,
Florence R. Sabin

Cushing's reply of two days later:

October 25, 1929

Dear Dr. Sabin:

I am delighted to know that you are going to undertake a biography of Dr. Mall. He played such an important part in the modern development of scientific medicine that the facts of his life should be recorded. And then he was much more than that, a most unique figure and the developer of a great school of Anatomy. He was one of the great figures of the time no less so than Welch, Osler, and Halsted.

You know of course that Willie MacCallum is doing a Life of Halsted, and he may very likely have run across some letters. But I found to my chagrin that these men, though they communicated with one another, never kept their letters. Just imagine what a mine of treasures Popsy himself has thrown into the waste paper basket. All he could say to me was that he had had a myriad of most amusing and entertaining and delightful letters from Osler but had never kept any of them. Mall of course corresponded with His and that I should think would be the chief source to be tapped if the letters have been preserved.

I am not so sure about the Luther and Erasmus. I look upon Mall as a combination of the two. Luther nailed his proclamation on the church door - devil take the hindmost - whereas Mall went about it more quietly. Still, I think the comparison could be effectively worked up. I shall look over my papers and see if I can find anything, but I don't believe

there is anything more than a few scraps for after all I was not a person to whom he would have felt called upon to write.

I will enclose a copy of the only letter I have at hand. It was written when the move was on foot to get him here to start an Institute of Embryology. I do not think he felt that the University as a whole (Minot aside) showed any great enthusiasm. But then, people in this Puritanical part of the world don't show enthusiasm about anything, enthusiasm being rather bad form.

It is kind of you to have mentioned my address so pleasantly. I am afraid there wasn't much in the suggestion it contained, but it was the only idea I had to throw out.
Much power to your elbow.

Always affectionately yours,

This work was five years in the making. The Story of a Mind, the biography of Franklin Paine Mall, was finally published in 1934 by the Johns Hopkins Press.

The following letter was written by Simon Flexner to Doctor Cushing; the latter had moved to Yale University School of Medicine and the New Haven Hospital, New Haven, Connecticut:

New Canaan, Conn.
September 18, 1934

Dear Harvey:

Very many thanks for the letter of September 4 and the reprint of the Syracuse address. I shall, of course, read the address: this should have been done immediately but for the pressure of Rockefeller Institute affairs. We are spending the summer so near New York this year that it is almost like being in harness. However, this is exaggeration, as the country about here is very pleasant and there has been recreation enough. The "address" shows wide "research", and the reading of it will be something more than an hour's refreshment. Of this more anon.

I want also to thank you for the address of the Rev. D. W. Learned to whom I have written, and that of the Rev. L. W.

Hicks, to whom I will write when next in New York. The other names and addresses are most gratefully acknowledged. I shall try getting in touch with Mr. Grinnell.

Gradually letters and other materials of Dr. Welch are piling up. Everyone is cooperative. I am abashed, however, at the task ahead; you know so well what it is to go through a vast collection of biographical material, arrange, select, etc. Shall I ever manage it!

You know, of course, that Dr. Sabin has been at work on a biography of Mall. It is just appearing at the end of five years of work. I am taking great pleasure in sending you a copy; I believe that she has done an excellent job of the life.

Some day you may have me knocking on your door in New Haven, for advice.

Yours,

Simon Flexner

Flexner also wrote a review of Sabin's book, published in the New York Times on October 21, 1934, in which he remarked:

> Dr. Sabin has written a vivid life of Dr. Mall. She was well equipped for the task; herself a distinguished teacher and investigator, an associate and pupil of Mall for twenty years, no one understood so well the gifted and somewhat whimsical personality, or followed more closely his scientific work, or could better render its meaning in nontechnical language. The book follows in detail, but not too much detail, the growth of an extraordinary intellect.
>
> Simon Flexner

Cushing, after reading the copy of the book which Flexner had sent to him, wrote the following letter to Sabin:

7 December 1934

Dear Florence Sabin:

I want to call your attention to a nice review of your book about Dr. Mall in the current British

> Medical Journal for November 24th, page 944. I hope you are getting many pleasant notes about the book which I have read with the greatest delight.
>
> Sincerely yours,
>
> Harvey Cushing

Sabin's reply of a few days later:

> December 12, 1934
>
> Dear Doctor Cushing:
>
> Thanks so much for calling my attention to the review of my book in the British Medical Journal. I am so delighted that you have read my book and approve of it. Sometime I should be very happy to have a frank discussion of your feeling about the chapter on Full-Time Medicine.
>
> Cordially yours,
>
> Florence R. Sabin

As can be assumed from the context of this letter, Mall's ideas about the full-time plan of teaching in clinical medicine were still on trial. More important than this was the fact that with the publication of Sabin's book, twenty years after the so-called trial began at Hopkins, the profession was finding out how much of a part Mall had played in this reform. This is substantiated by Cushing's reply to Sabin:

> 14 December 1934
>
> Dear Florence:
>
> Thanks for your note. I thought the chapter on full-time medicine was excellent. Dr. Mall always kept so much in the background it was difficult to know what in his quiet way he was bringing about, but I am quite sure that he really had more to do with the movement than anyone else.
>
> It has unquestionably done a lot of good, but

> just how it is going to work out in the future I am not quite sure. I am on full time here at Yale, as I chose not to be at Harvard. Like any system, it enervates some people and activates others, and like everything else depends much on character and personality. Some day let's get together and thrash it out with one another.
>
> With Christmas greetings, I am
> Always sincerely yours,

The dynamic cellular studies on living connective tissue and blood cells carried out by Sabin during the Hopkins period began to bear relationship to the understanding of body defenses. This attracted the interest of Dr. Simon Flexner, Director of the Rockefeller Institute for Medical Research. Dr. Flexner desired to established a well-planned study of both the cellular and humoral aspects of resistance to disease, in hopes that further progress in the knowledge of these processes might be made. He therefore journeyed to Baltimore and urged Sabin to accept full time membership on the staff of the Rockefeller Institute, the first such position to be offered to any woman scientist in this country, so that she would organize and direct a group of investigators who might correlate the emerging cellular concepts with serologic information already available. Sabin accepted this challenge and established a Department of Cellular Studies in New York. The thirteen years which she spend in New York City at the Rockefeller Institute for Medical Research were abundantly studded with scientific achievement, most important of which was the establishment of the principle that the cellular and humoral forces in the defense mechanism of the body are inseparable.

This period was showered with paper after paper, recording the progress that this group was making. The obligation to publish when progress is achieved was another concept carried over from the Mall-Ludwig-His school. Sabin often said:[117]

> The investigator who holds back his conclusions until he is absolutely sure, never progresses far. When I reach certain conclusions, I do not hesitate to publish them, even though, after further study, I may find I was wrong; then I do not hesitate to say that I have changed my mind.

Although Sabin may have honestly felt this way, there are those who knew that to prove her wrong was to incur disaster. All have agreed that she was an excellent observer, but many have felt that she would on occasion unfortunately let her interpretations be guided by her preconceptions. It was also well known that Sabin's criticisms of other investigators were quite effective in a variety of ways.

An amusing example of this is recorded in a letter to Dr. Cushing, who had previously asked Sabin's opinion regarding the publication of some experimental work done by a member of his laboratory. Sabin's reply was:

> April 4, 1930
>
> Dear Doctor Cushing:
>
> . . . . It interested me especially and I wanted to assure you again that when I was asked about publication for Doctor Fried's work, I had recommended that it be published. It seems to me most essential always to speed to publication articles when one does not agree with them. That I learned from Doctor Mall and I most assuredly did so.
>
> Very cordially yours,
>
> Florence R. Sabin

A second method of attack is illustrated by an experience with Dr. Huntington of the College of Physicians and Surgeons, Columbia University. Apparently Huntington doubted the validity of Sabin's methods of investigation in reference to the injecting of some of the young lymphatic vessels with dyes; in the midst of a mildly tepid debate, Sabin is quoted as calmly saying: "Dr. Huntington's discussion is not quite that of a gentleman." A very effective method, to say the least.

Regardless of the difference of opinion manifested by various groups of investigators, a rather common occurrence in all fields of research, the Rockefeller Institute Period produced some noteworthy results. Sabin will always be remembered for her detailed experiments and histological studies of the development of the cells of the blood and of the reaction of the tissues of the body to the tubercle bacillus. Techniques which she devised, particularly that of studying living cells under suitable conditions of temperature and humidity, are in use all over the world today for a variety of purposes. In the field of hematology, the beautifully illustrated series of monographs produced by Sabin and her collaborators at the Rockefeller Institute are monumental. Though her conclusions on the origin of the red blood cell may not now be generally accepted, the stimulus her work gave to contemporary hematologists was immense.

Sabin's investigations in the field of immunology were major contributions to the better understanding of tuberculosis. Even more

significant, was the development from these studies of the broad general concepts of globulin-antibody formation directly from the reticulo-endothelial system. Sabin developed the globulin-antibody concept by injecting marked antigens and observing the phagocytosis of antigens into the vacuoles of the cells of the reticulo-endothelial system. The antigens were made soluble by the vacuoles and then passed into the cytoplasm, which was thought to be the zone of synthesis. There, in some way, the antigen was thought to increase the synthesis of globulin, which was then modified into antibody globulin. Following this, the antibody-globulin was carried into the blood plasma. Concomitantly with the latter reaction, the serum antibody-globulin was shown to rise. Sabin also thought that it was possible for the cell which had formed a new kind of globulin to retain the globulin and therefore be sensitized, meaning that it would react differently from the normal cell in the presence of the original antigen.[114]

In conjunction with this theory, Sabin and her group attempted to isolate a chemical fraction of the tubercle bacillus which would produce a resistance to tuberculosis in the host. This investigation was carried out under the program of the Committee on Medical Research of the National Tuberculosis Association, under the Chairmanship of Dr. William Charles White. That such material exists had been proved by the enhancement of resistance by means of heat-killed tubercle bacilli, as well as, by living virulent or attenuated tubercle bacilli,

"Bacille Calmette-Guerin."

The basic plan of the Committee had been that standard strains of tubercle bacilli should be selected, grown on synthetic media without protein, and then analysed chemically. The different chemical fractions were to be tested biologically in an effort to trace, first, their role in the pathology of the infection and, second, their effect on the course of the disease. These studies represent the combined work of Sabin's group over thirteen years.

In general, every cellular reaction recognized in the lesions of the disease tuberculosis could be reproduced by fractions isolated from tubercle bacilli, but none of the fractions studies up to that time, and even at the present time, had brought about any change in resistance to the disease. The materials studied were lipids, polysaccharides and proteins. The tuberculolipids and proteins all induced a new formation of monocytes; the phosphatide changed monocytes into epithelioid cells and their derivative giant cells; the waxes induced the fusion of monocytes into foreign body giant cells; the proteins induced a more varied stimulation of monocytes, that is, into epithelioid cells, macrophages and both types of giant cells. The polysaccharides were chemotactic to neutrophilic leucocytes; monocytes were involved only indirectly in that they eventually phagocytized extravasated neutrophilic leucocytes.

For these outstanding achievements, Sabin gained due recognition throughout the country. In 1928, she received the 6th Annual

Achievement Award of the Pictorial Review, "to the American woman who, in the opinion of a distinguished committee, has made the most distinctive contribution to American life in the fields of arts, letters, or the sciences," presented in the form of a $5,000 check at a luncheon in her honor. Following this, she became, in 1935, the third recipient of the M. Carey Thomas Prize, which was given at intervals to an American woman in recognition of eminent achievement. The presentation of the Bryn Mawr Award to Sabin, again with a check for $5,000, was made with the following comments, by Simon Flexner, who at that time had retired as director of the Rockefeller Institute for Medical Research.

> Your fruitful years of teaching and research, in which you united a love of work and a love of your pupils, have won you an abiding place in the hearts of your contemporaries and have made you the worthy recipient of this prize."[25, 28]

In her response on receiving this award, presented on the occasion of the 50th anniversary of the founding of Bryn Mawr College, Florence Sabin took the opportunity to voice her opinion of "women in science." If we acquaint ourselves with the history of the national movement of women to achieve prominence in, and contribute to, the progress of politics, science, art and education in this country, we become aware that a certain few were the pioneers who, through their exceptional ability and unbreakable spirit, laid the foundation for the equal, or nearly equal recognition and opportunity which exists for men and women today. Women such as Madame Curie, M. Carey Thomas,

Willa Cather, Mary E. Garrett, and many others including, of course, Florence Sabin, by their example and success, proved that women deserved equal opportunity and recognition.

Sabin felt very strongly about the hurdles which women had to overcome in order to obtain equal rights. She contributed to this movement for emancipation directly by public support and indirectly through success and achievements which merited her public recognition and a myriad of honorary degrees, influential appointments and personal awards.

Sabin's picture would often be seen with those of other outstanding women of the day in the numberless articles which were being written in an effort to advance the position of the career woman in the professional world.

Early in 1931, she was chosen, for the second time, as one of the twelve greatest living women in America.[17] In August of the same year she was appointed to the Advisory Board of the John Simon Guggenheim Memorial Foundation, designed to improve the quality of education and the practice of the arts and professions in the United States, as well as to foster research and to provide better international understanding. The foundation was established by former United States Senator Guggenheim as a memorial to a son who had died in 1922.[18]

In June of the following year, Sabin received the first National Achievement Award, a medal conferred by the Chi Omega Sorority in

recognition of a notable achievement by a woman.[20]

The honorary degree of Doctor of Science was conferred upon her by New York University, Syracuse University, Oglethorpe University, and Oberlin University.[22, 23, 24, 26, 31]

Dr. Sabin was again named as one of the ten most prominent American women for the year 1935 by Mrs. Carrie Chapman Catt, pioneer suffrage leader.[29]

In April of 1939, to the surprise of scientists all over the United States, the Rockefeller Institute for Medical Research enforced retirement rules on its working scientists for the first time and suddenly announced the withdrawal of five of its most brilliant members. These investigators, Phoebus Aaron Theodore Levene, Winthrop John Vanleuven Osterhaut, Karl Landsteiner, Alexis Carrell, and Florence Rena Sabin were described as five of the keenest scientific brains on earth.[125]

In the late '20s callers at her laboratory at the Rockefeller Institute were welcomed by a kindly woman, tall and comfortable-looking with greying hair and shrewd eyes, obviously working at the bench with her collaborators. The visitor, perhaps shy and young, would be taken in, talked to, shown what was then the exciting "hot box technique," and made to feel a colleague - something that matters much in the early stages of research. "It matters little," she would say, "whether men or women have the more brains; all we women need to do to exert our proper influence is just to use all the brains we have." Said one of

her pupils: "It is like a revival of learning when Dr. Sabin comes around."[20]

At the age of 67, and after 13 years at the Institute, Florence Rena Sabin ended her second career.

FLORENCE SABIN - - A GREAT CITIZEN

THE PUBLIC HEALTH PERIOD

1944-1951

Following Dr. Sabin's enforced retirement, she returned to her native state of Colorado. There she lived contentedly with her elder sister, Mary, in a Denver apartment. She was delighted finally to have time for her own cooking and for her hobby of photography. In the latter, she was very accomplished, often making Christmas cards from photographs. With her philosophy that work is a basic requisite for inner satisfaction and that happiness comes only from activity, it was inevitable that she would find an outlet for the enthusiasm and energy which had marked her earlier achievements.

There were those who thought that just another tired old lady had come back to Colorado. She was sixty-seven and looked it, her hair in a bun, her dresses longer than the fashion, her glasses, the rimless type popular a generation before.

Her neighbors knew, in a vague sort of way, that she had been highly distinguished back East. If they had troubled to investigate, they would have found that this calm, poised, alert, elderly woman, somewhat above medium height, and blessed with a strong constitution that had been supported by strenuous summers in the Colorado mountains, was a neat package of dynamite with more blue ribbons than one could pin on an ordinary chest. But nobody did look up her record; if anyone had, Florence Sabin probably never would have started on her third career.

It all began quietly, in 1944, when Colorado's Governor, John C. Vivian, drew up a list of names for appointment to a Post-War

Planning Committee. He showed the list to Frances Wayne, of the Denver Post, an ardent feminist. Miss Wayne hit the roof when she saw that there was not one woman's name on it. Hastily the governor asked her suggestions. And thus it came about that the Sub-Committee on Health was headed by Florence Sabin, retired M. D., aged seventy-three. A very benign position - after all Colorado's Rockies were a health resort, so Colorado must be healthy.

Sabin took her new job seriously, just as she did everything else. She found herself up against a combination of lack of interest, inertia, ignorance, and political power which was sufficient enough to make public health and preventive medicine in Colorado as important as a quart of water going over Niagara Falls.

Sabin knew that in order to overcome these obstacles she would have to rely on the people of Colorado. They had to know how badly Colorado needed public health reforms. So she proceeded to pin down the facts beyond all possibility of argument. The Commonwealth Fund of New York was willing to put up the money necessary for the American Public Health Association to enter Colorado and compile the necessary data, but the Fund demanded in return a formal request from the governor of Colorado to prove that the state really meant to act on the report, and not merely to file and forget it. Back to Colorado went "old Flossie." But delay followed delay. The State House was in no hurry to bring in outside critics. Even a protesting committee drew from the governor only a flabby, non-committal letter, almost certain to

bring rejection. Florence Sabin was not to be brushed off lightly. Her own message, quite apropos, followed the governor's back East. "Don't let one man's disinterest block the welfare of an entire state," she pleaded.[4]

Out to Colorado came Dr. Carl E. Buck of the American Public Health Association to make a year-long study of the State's health laws and medical facilities. By January of 1946 he was ready to submit his report.

It showed that the beautiful health resort, Colorado, actually stood far down the list among the states. Thirty-four had better records for deaths from preventable or controllable diseases. Only two states had worse records in deaths from scarlet fever. Only five from diphtheria. Forty-one states had better records than Colorado on diarrhea-enteritis deaths and pneumonia fatalities, and forty states had lower infant mortality rates.

In the five years from 1940 through 1944, 14,622 Coloradans had died from controllable and preventable diseases. In half a decade, 8,245 Colorado citizens had died needlessly, for every one of the "preventable" deaths was unnecessary, and at least half of those who died from "controllable" causes could have been saved; more than three times as many as Colorado lost in the armed services during the entire war![121, 123]

Buck stated that Colorado was giving its Division of Public Health less than ten cents per capita to protect the health of its

citizens. All the rest of its pitifully small public health expenditures were coming from federal aid, from the United States Public Health Service and the Children's Bureau. The State appropriations were but 14 percent of Colorado's total health expenditures.[121, 123]

A major factor was the political control of the State Health Division. The Civil Service Commission, itself a political barrier, had been blocking the appointment of qualified health officials. Six of the principal administrative positions in the state's puny health agency were vacant, and the salaries in surrounding states averaged 26 percent higher than in Colorado. Dr. Buck discovered that only five of the sixty-three counties had local health departments, and three of these were without full time health officers.[121, 123]

Most localities simply never had undertaken the health-protecting functions that are present throughout the United States. There was found to be no effective control of the milk supply because the Health Division had no authority to regulate milk production or dairy herds. Only two counties and nine towns in the entire state were operating under the Standard Milk Ordinance of the United States Public Health Service. Only 16 percent of the communities had modern sewage systems; nearly half had no systems at all, and the rest had systems incapable of purifying sewage before it was dumped into the streams to pollute irrigation waters and contaminate truck farm crops.[121, 123] Buck also discovered that the state's available hospital beds for the citizens of Colorado afflicted with tuberculosis were only 574, less than half of the minimum number required.[121]

Nobody could contradict these facts. The next move was to rouse the citizens of Colorado. Paying expenses out of her own pocket, Sabin began to tour the state, hammering home the grim meaning of the Buck report. In the larger cities she spoke to packed halls. But she never refused an invitation, even when it meant crossing the Rockies to address a handful of people in some back-valley village. She used slogans and established a state-wide campaign: "Politics, Pasteurization, and Pollution."--"Health to match our mountains."[126]

In November of 1946, she was scheduled to speak at the little town of Sterling, 125 miles away from her Denver home. At daybreak, Herbert D. Moe, executive secretary of the Committee on Health phoned to say there was eight inches of snow and suggest the meeting be cancelled. Her answer was, "Meet me at nine--and don't forget your rubbers." By the time they started, the state highway patrol was broadcasting warnings to all cars to get off the roads. Again Moe tried to give her an excuse, proposing to speak in her place. "If you can make it alone," she snapped, "you can make it with me."[4]

"There she sat," Moe relates admiringly, "with a shawl tied over her head, like a quiet little old grandmother on her way down the street to tea. It was 1:30, with the snow near our hubcaps, before we reached Brush. 'Thirty miles to go,' I said, making a last try at getting out of it."

"Well," she answered, looking calmly at her watch, "we've still

got thirty minutes. Let's make it."[4]

It was at such meetings that Sabin did her most effective work. After a lifetime of cloistered and often lonely scientific research, she demonstrated - much to her own surprise - an amazing ability to open hostile minds, to win people over almost against their will.

State Senator Price Briscoe tells how she recruited her committee:

> I was just an ex-Senator minding my own business and running a gold mine when Dr. Sabin came tromping in here one day last Spring. I'd never heard of her before, but they phoned and called me down to the drugstore in Idaho Springs. There was a little bump of a woman with a twinkly sort of smile that made her eyeglasses seem to light up. She looked so tiny and ineffectual, sitting on a high stool at the soda fountain. We ordered two cokes and she started to talk. We had two more, and then another round. She must have spiked mine because before I knew it, I had promised to work on her committee--and look at me now!
>
> I'm back in the State Senate, diligently neglecting my business. I spend half my time at health meetings in Denver, and half the rest rooting things up elsewhere for the little lady. Neighbors are beginning to console my wife when they find her alone, as if I had a girl friend down in the city. And I'm not the only one. Dr. Sabin has scores of people just like me, who've caught the torch for something that nobody ever could have gotten us excited about before.[4]

Thus, touring the state--the mining villages, the college towns, the short grass country, and the isolated Western Slope--Sabin and her committee built up a wave of public indignation which toppled many anti-Sabinites from their high public positions. The millionaires of Colorado Springs and the poorest itinerant beet pickers could be found fighting side by side. D.A.R. chapters,

farmers' groups, chambers of commerce, and welfare organizations all joined the campaign. Newspapers picked it up. Parent-teachers organizations contributed by printing and distributing 70,000 folders on the Buck report and Sabin program.[4]

During the next state elections, both gubernatorial candidates spent half their time protesting that each was more strongly for Sabin's health program than the other. In county after county, assembly and senate candidates who tried to pussyfoot on health legislation went down to defeat while newcomers who endorsed the Sabin proposals were elected.[4]

Lee Knous was elected the new governor of Colorado. Every campaign speech had stressed his support for the health bills. Knous was a Democrat who ousted a Republican administration despite Republican landslides almost everywhere else. When asked how he expected to pass such bills through a legislature controlled by his political opponents, he replied: "Brother, when it comes to those bills . . . why, I'll have the little old lady on my side. There isn't a man in the legislature who wants to tangle with her. She's an atom bomb. She's a dynamo."[4]

Sabin insisted that her main job had been "to take health out of politics." But actually she had succeeded in putting politics right into the middle of the health picture and politicians out in the open where they have been forced to take a stand.

As Albert Q. Maisel put it, in his article on Sabin's public

health career:

> It was Sabin who held the shotgun for the "shotgun wedding" of the Civil Service Commission and the State Board of Health. The civil service people had acknowledged their past failures and promised to do better in the future. The health people had agreed to submit new job specifications and salary recommendations. And both groups started busily plotting a joint campaign to force the legislature and the governor to come through with bills and a budget that would make it possible to secure long-needed, qualified personnel. After it was all over, one of the civil service men shook his head and muttered, "Hot damn, that woman is wonderful. She sits there so quiet you get to think you're dealing with Whistler's mother. It's only after you have gone home that you realize you have promised her your coat, vest, and shirt."[4]

The medical profession opposed Sabin when they discovered they could not have a majority of the members on the proposed new State Board of Health. Sabin convinced them that it might be more democratic--and certainly more palatable to the legislature--if they would be content to cooperate with laymen instead of dominating the picture. Dairy interests, which had defeated most of the public health proposals in past years, were prepared to veto any proposal that the health committee offered. Much to their surprise, they found the Sabin group discussing a bill for cattle inspections, pasteurization, and vaccination that the committee hoped the cattle men would sponsor as their own. Even more to their surprise, they left the meeting having promised to do so. Old-line politicians, who had become her strongest supporters, found themselves continually amazed by the "little old lady. They would try to protect her to make certain that she would still be around to fight for her bills

when they came up before the legislature. But often at the end of a long meeting, the protectors found themselves completely worn out, while their idol sat at the head of the table, fresh and smiling.[4]

By October 21, 1946, just two years after Sabin began her task, she had won the warm support of the whole state of Colorado, had nailed health planks into both Democratic and Republican party platforms, had eight model health bills for the upcoming session of the legislature (including one to take health administration from the governor's control), and had badgered Denver's Mayor Benjamin Stapleton into a promise to "consider" a city health survey.[123]

Of the eight bills presented to the legislature, the first two concerned public health services. The State Reorganization Bill created a new Department of Public Health, with a Board of Health and an Executive Division. The Board of Health was to be composed of nine members appointed by the Governor in such manner that no business or professional group would constitute a majority. This concession was made by the doctors. The bill gave to the new department powers adequate to meet its responsibilities in improving the health of the state. The second health bill was permissive legislation for facilitating the setting up of county, city-county, and multiple-county health units. Both of these bills passed early in the session.[123]

The third bill, with appropriations for all divisions of government, was presented late in the session. The requests were in two parts--one for the State Department and the other for aiding county

units. These bills were given intensive study by the appropriations committee and, though no group obtained all it asked for, the Health Department received funds adequate for great improvement of its services. The grant for state aid to the counties was raised from nothing to $150,000 for the biennium.[121, 123]

The fourth bill was an enabling act to meet the federal requirements for participating in the new hospital construction program. The fifth bill was an appropriation bill for the medical school. Under the new Dean, Dr. Ward Darley, plans had been developed to stress public health and the training of more general practitioners, rather than specialists. These plans were an important advance in medical education and the committee was glad to endorse this program.[4, 121, 123]

Three special bills pertaining to specific diseases were also submitted: two were to lessen the incidence of tuberculosis, the third was to decrease the frequency of Bang's disease in dairy cattle. The bills in regard to tuberculosis were drawn by the State and Denver Tuberculosis Associations and endorsed by the Health Committee. An increase in the per diem allotment to hospitals of from $4 to $6 for the care of indigent cases was obtained. It was hoped to obtain money for the construction of a new wing of 100 beds at the Colorado General Hospital under the direction of the Medical School, but support was won for a 30-bed ward only. This did, however, aid in the development of chest surgery in the state, place a number of tuberculosis patients in a general hospital, and help with the training of medical students

in this disease.[121]

The so-called Cow Health Bill was the only complete defeat of the committee. It was drawn by a veterinarian on the committee in the effort to check the sale of dairy cows that are reactors to Bang's disease. It did not include compulsory testing nor require slaughter, but simply the quarantining and reporting of infected cows. The bill was killed by the livestock interests through having it referred to the Livestock Committee, where it was permanently buried. Colorado's important beef and dairy cattle industries made the eradication of Bang's disease unusually difficult. The inter- as well as intra-state shipment and sale of infected animals complicated control measures. This disease, at that time, was a national problem. Some of the questions that needed further investigation were: how could you account for the fact that a cow may react negatively to the agglutination test and at the same time show a positive blood culture? How effective was calf vaccination?[119]

The second problem which needed study was the lack of public health personnel. During the next few years, Sabin attempted to solve both of these problems in the hope that Colorado's Public Health Department would be free of vulnerable positions.

Again using undisputable facts and figures, Sabin showed the tremendous losses each year in the cattle and dairy industry in Colorado due to diseased animals. The data on losses were so impressive that it was not too difficult a task to convince the dairy industry

that preventive measures pay in terms of increased dividends. The Governor appointed a special committee with representatives of the livestock industry, of the dairy groups, of the veterinarians, of the public health forces, and of the public to make a study of the best possible control measures for Bang's disease.[121]

In attacking the problem of lack of public health personnel, Sabin attempted to get the state to increase appropriations for education and research so that the University of Colorado's School of Medicine could build additional laboratory facilities and increase its medical student body. Sabin also made known the need for more nurses and more sanitary engineers, in an effort to supply adequate personnel to the public health department. It was not until December, 1951, that the Florence R. Sabin Building for Research in Cellular Biology was completed and dedicated at the University of Colorado Department of Medicine, in Denver. Her colleagues honored her at the dedication dinner and presented her with a bound volume of felicitations from all parts of the country.[49] The funds that were contributed for the erection of this building came from many organizations, some of which were national. Even Sabin herself contributed financially in addition to giving many hours of work to convince the public that such a building is absolutely necessary.[121]

Because of her extraordinary achievements, Sabin was elected President of the Western Branch of the American Public Health Association and President of the Denver Board of Health and in October, 1947,

she was unanimously elected an honorary Fellow of the American Public Health Association.

The Public Health Period also brought to Sabin her usual individual recognition. In 1945, she received the Trudeau Medal of the National Tuberculosis Association, the highest honor in the field of tuberculosis, for her "meritorious contribution to the cause, treatment or prevention of tuberculosis."[37] In 1947, she was awarded the Jane Addams Medal at the 100th anniversary celebration of Rockford College. The medal, presented for the first time, was in recognition of her "untiring achievements" in Colorado public health work.[38] During the same year, Sabin received the American Woman's Association medal for eminent achievement and the science citation of the National Conference of Christians and Jews.[40] In 1951 she received the Lasker Foundation award for her achievements as a leading spirit in public health programs in Colorado and the General Rose Memorial Hospital's medal for distinguished public health service.[49]

The year 1951 brought to a close the third - and last - of Sabin's careers. At the age of 80, she retired, once again, to her Denver apartment. If she had been asked to tackle another problem, she would have undertaken it willingly and successfully. She could not have done otherwise, for achievement was a natural result of her every endeavor.

IN MEMORIAM

In January, 1953, Sabin received the Elizabeth Blackwell Citation of the New York Infirmary in honor of her life's work.[44]

Three careers, each one productive, each one influential, each one successful, and each one the result of definite research ideas and intellectual integrity were combined with the boundless enthusiasm and tireless energy of a great American woman.

Success is difficult to define, for it conveys different meanings in varying circumstances. But to Sabin, success meant that there was still time to accept a new challenge. Each challenge was an adventure for her and each adventure met with some degree of success.

She was more than a scientist; she was a woman who loved humanity - the humanity about her struggling and suffering.

> A time will come when men and women will live their alloted span quietly, peacefully, without illness, free from pain, until they pass gently, as a tired child closes sleepy eyes, from this world to the next.

These words of Sabin embody her credo, an aim toward which she devoted her life, tirelessly and fruitfully.[117]

And these words also characterize her death. Florence Rena Sabin lived to the age of 81, "peacefully, without illness, free from pain," and on Saturday, October 3, 1953, died at her Denver home after a heart attack.

If she had the power of choice, she would have lived her life over again exactly as it was, trying to do just the same things. That, without her suspecting it perhaps, was the final seal of success upon her

life. She had moved in her chosen road to her chosen goal with her every effort.

No one who has worked with her will ever forget her; and all who have been privileged to have that opportunity are better for it.

Simon Flexner called her "the greatest living woman scientist and one of the foremost scientists of all times."[48] Nobility of spirit, sincerity of purpose and unremitting effort have their own reward.

In 1956, a sculpture was placed in Statuary Hall in the Capitol in Washington, in honor of Florence Rena Sabin, Teacher - Scientist - Citizen.[131]

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